SEQUENCE LISTING

<110> The Scripps Research Institute
Schultz, Peter
Wang, Lei

<120> SITE SPECIFIC INCORPORATION OF KETO AMINO ACIDS INTO PROTEINS

<130> 54A-000170PC

<140> PCT/US 03/32576
<141> 2003-10-15

<160> 24

<170> PatentIn version 3.1

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gatgaaaatc caaaggttgc tgaagttatc tatccaataa tgcaggttaa ttgttctcat 480

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tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

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tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

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ccaattagaa agagatta 918

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gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240

gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300

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gatgaaaatc caaaggttgc tgaagttatc tatccaataa tgcaggttaa tcggccgcat 480

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ggagaaggaa agatgagttc ttcaaaaggg aattttatag ctgttgatga ctctccagaa 660

gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

ataatggaga tagctaaata cttccttgaa tatcctttaa ccataaaaag gccagaaaaa 780

tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

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ccaattagaa agagatta 918

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gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240

gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300

aaatatgttt atggaagtcc tttccagctt gataaggatt atacactgaa tgtctataga 360

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ggagaaggaa agatgagttc ttcaaaaggg aattttatag ctgttgatga ctctccagaa 660

gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

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tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

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atacatttag ggcattatct ccaaataaaa aagatgattg atttacaaaa tgctggattt 180

gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240

gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300

aaatatgttt atggaagtac gttccagctt gataaggatt atacactgaa tgtctataga 360

ttggctttaa aaactacctt aaaaagagca agaaggagta tggaacttat agcaagagag 420

gatgaaaatc caaaggttgc tgaagttatc tatccaataa tgcaggttaa tacgtatcat 480

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ggagaaggaa agatgagttc ttcaaaaggg aattttatag ctgttgatga ctctccagaa 660

gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

ataatggaga tagctaaata cttccttgaa tatcctttaa ccataaaaag gccagaaaaa 780

tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

gaattgcatc caatggattt aaaaaatgct gtagctgaag aacttataaa gattttagag 900

ccaattagaa agagatta 918

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atacatttag ggcattatct ccaaataaaa aagatgattg atttacaaaa tgctggattt 180

gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240

gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300

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ttggctttaa aaactacctt aaaaagagca agaaggagta tggaacttat agcaagagag 420

gatgaaaatc caaaggttgc tgaagttatc tatccaataa tgcaggttaa taatacgcat 480

tatgggggcg ttgatgttgc agttggaggg atggagcaga gaaaaataca catgttagca 540

agggagcttt taccaaaaaa ggttgtttgt attcacaacc ctgtcttaac gggtttggat 600

ggagaaggaa agatgagttc ttcaaaaggg aattttatag ctgttgatga ctctccagaa 660

gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

ataatggaga tagctaaata cttccttgaa tatcctttaa ccataaaaag gccagaaaaa 780

tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

gaattgcatc caatggattt aaaaaatgct gtagctgaag aacttataaa gattttagag 900

ccaattagaa agagatta 918

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atacatttag ggcattatct ccaaataaaa aagatgattg atttacaaaa tgctggattt 180

gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240

gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300

aaatatgttt atggaagtca tttccagctt gataaggatt atacactgaa tgtctataga 360

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gatgaaaatc caaaggttgc tgaagttatc tatccaataa tgcaggttaa tcagactcat 480

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ggagaaggaa agatgagttc ttcaaaaggg aattttatag ctgttgatga ctctccagaa 660

gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

ataatggaga tagctaaata cttccttgaa tatcctttaa ccataaaaag gccagaaaaa 780

tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

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ccaattagaa agagatta 918

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atacatttag ggcattatct ccaaataaaa aagatgattg atttacaaaa tgctggattt 180

gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240

gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300

aaatatgttt atggaagtaa gttccagctt gataaggatt atacactgaa tgtctataga 360

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gatgaaaatc caaaggttgc tgaagttatc tatccaataa tgcaggttaa tccgtgtcat 480

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gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

ataatggaga tagctaaata cttccttgaa tatcctttaa ccataaaaag gccagaaaaa 780

tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

gaattgcatc caatggattt aaaaaatgct gtagctgaag aacttataaa gattttagag 900

ccaattagaa agagatta 918

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atacatttag ggcattatct ccaaataaaa aagatgattg atttacaaaa tgctggattt 180

gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240

gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300

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gatgaaaatc caaaggttgc tgaagttatc tatccaataa tgcaggttaa tgtgattcat 480

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agggagcttt taccaaaaaa ggttgtttgt attcacaacc ctgtcttaac gggtttggat 600

ggagaaggaa agatgagttc ttcaaaaggg aattttatag ctgttgatga ctctccagaa 660

gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

ataatggaga tagctaaata cttccttgaa tatcctttaa ccataaaaag gccagaaaaa 780

tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

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ccaattagaa agagatta 918

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gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

ataatggaga tagctaaata cttccttgaa tatcctttaa ccataaaaag gccagaaaaa 780

tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

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ccaattagaa agagatta 918

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atacatttag ggcattatct ccaaataaaa aagatgattg atttacaaaa tgctggattt 180

gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240

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tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

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gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240

gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300

aaatatgttt atggaagttc cttccagctt gataaggatt atacactgaa tgtctataga 360

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tatctgggcg ttgatgttgc agttggaggg atggagcaga gaaaaataca catgttagca 540

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gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

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ccaattagaa agagatta 918

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gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240

gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300

aaatatgttt atggaagtaa tttccagctt gataaggatt atacactgaa tgtctataga 360

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gatgaaaatc caaaggttgc tgaagttatc tatccaataa tgcaggttaa tccgcttcat 480

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ggagaaggaa agatgagttc ttcaaaaggg aattttatag ctgttgatga ctctccagaa 660

gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

ataatggaga tagctaaata cttccttgaa tatcctttaa ccataaaaag gccagaaaaa 780

tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

gaattgcatc caatggattt aaaaaatgct gtagctgaag aacttataaa gattttagag 900

ccaattagaa agagatta 918

<210> 15
<211> 918
<212> DNA
<213> artificial

<220>
<223> tRNA synthetase based on M. jannaschii tyrosyl-tRNA synthetase

<400> 15
atggacgaat ttgaaatgat aaagagaaac acatctgaaa ttatcagcga ggaagagtta 60
agagaggttt taaaaaaaga tgaaaaatct gctacgatag gttttgaacc aagtggtaaa 120
atacatttag ggcattatct ccaaataaaa aagatgattg atttacaaaa tgctggattt 180
gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240
gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300
aaatatgttt atggaagtct gttccagctt gataaggatt atacactgaa tgtctataga 360
ttggctttaa aaactacctt aaaaagagca agaaggagta tggaacttat agcaagagag 420
gatgaaaatc caaaggttgc tgaagttatc tatccaataa tgcaggttaa tcctcttcat 480
tatgagggcg ttgatgttgc agttggaggg atggagcaga gaaaaataca catgttagca 540
agggagcttt taccaaaaaa ggttgtttgt attcacaacc ctgtcttaac gggtttggat 600
ggagaaggaa agatgagttc ttcaaaaggg aattttatag ctgttgatga ctctccagaa 660
gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720
ataatggaga tagctaaata cttccttgaa tatcctttaa ccataaaaag gccagaaaaa 780
tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840
gaattgcatc caatggattt aaaaaatgct gtagctgaag aacttataaa gattttagag 900
ccaattagaa agagatta 918

<210> 16
<211> 918
<212> DNA
<213> artificial

<220>
<223> tRNA synthetase based on M. jannaschii tyrosyl-tRNA synthetase

<400> 16
atggacgaat ttgaaatgat aaagagaaac acatctgaaa ttatcagcga ggaagagtta 60
agagaggttt taaaaaaaga tgaaaaatct gctcttatag gttttgaacc aagtggtaaa 120
atacatttag ggcattatct ccaaataaaa aagatgattg atttacaaaa tgctggattt 180
gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240
gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300
aaatatgttt atggaagtac tttccagctt gataaggatt atacactgaa tgtctataga 360
ttggctttaa aaactacctt aaaaagagca agaaggagta tggaacttat agcaagagag 420
gatgaaaatc caaaggttgc tgaagttatc tatccaataa tgcaggttaa tccggttcat 480
tatcagggcg ttgatgttgc agttggaggg atggagcaga gaaaaataca catgttagca 540
agggagcttt taccaaaaaa ggttgtttgt attcacaacc ctgtcttaac gggtttggat 600
ggagaaggaa agatgagttc ttcaaaaggg aattttatag ctgttgatga ctctccagaa 660
gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

ataatggaga tagctaaata cttccttgaa tatcctttaa ccataaaaag gccagaaaaa 780

tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

gaattgcatc caatggattt aaaaaatgct gtagctgaag aacttataaa gattttagag 900

ccaattagaa agagatta 918

<210> 17
<211> 918
<212> DNA
<213> artificial

<220>
<223> tRNA synthetase based on M. jannaschii tyrosyl-tRNA synthetase

<400> 17
atggacgaat ttgaaatgat aaagagaaac acatctgaaa ttatcagcga ggaagagtta 60

agagaggttt taaaaaaaga tgaaaaatct gctactatag gttttgaacc aagtggtaaa 120

atacatttag ggcattatct ccaaataaaa aagatgattg atttacaaaa tgctggattt 180

gatataatta tattgttggc tgatttacac gcctatttaa accagaaagg agagttggat 240

gagattagaa aaataggaga ttataacaaa aaagtttttg aagcaatggg gttaaaggca 300

aaatatgttt atggaagttc gttccagctt gataaggatt atacactgaa tgtctataga 360

ttggctttaa aaactacctt aaaaagagca agaaggagta tggaacttat agcaagagag 420

gatgaaaatc caaaggttgc tgaagttatc tatccaataa tgcaggttaa tccactgcat 480

tatcagggcg ttgatgttgc agttggaggg atggagcaga gaaaaataca catgttagca 540

agggagcttt taccaaaaaa ggttgtttgt attcacaacc ctgtcttaac gggtttggat 600

ggagaaggaa agatgagttc ttcaaaaggg aattttatag ctgttgatga ctctccagaa 660

gagattaggg ctaagataaa gaaagcatac tgcccagctg gagttgttga aggaaatcca 720

ataatggaga tagctaaata cttccttgaa tatcctttaa ccataaaaag gccagaaaaa 780

tttggtggag atttgacagt taatagctat gaggagttag agagtttatt taaaaataag 840

gaattgcatc caatggattt aaaaaatgct gtagctgaag aacttataaa gattttagag 900

ccaattagaa agagatta 918

<210> 18
<211> 306
<212> PRT
<213> artificial

<220>
<223> tRNA synthetase based on M. jannaschii tyrosyl-tRNA synthetase

<400> 18

Met Asp Glu Phe Glu Met Ile Lys Arg Asn Thr Ser Glu Ile Ile Ser
1 5 10 15

Glu Glu Glu Leu Arg Glu Val Leu Lys Lys Asp Glu Lys Ser Ala Leu
20 25 30

```
Ile Gly Phe Glu Pro Ser Gly Lys Ile His Leu Gly His Tyr Leu Gln
        35                  40                  45

Ile Lys Lys Met Ile Asp Leu Gln Asn Ala Gly Phe Asp Ile Ile Ile
    50                  55                  60

Leu Leu Ala Asp Leu His Ala Tyr Leu Asn Gln Lys Gly Glu Leu Asp
65                  70                  75                  80

Glu Ile Arg Lys Ile Gly Asp Tyr Asn Lys Lys Val Phe Glu Ala Met
                85                  90                  95

Gly Leu Lys Ala Lys Tyr Val Tyr Gly Ser Glu Phe Gln Leu Asp Lys
            100                 105                 110

Asp Tyr Thr Leu Asn Val Tyr Arg Leu Ala Leu Lys Thr Thr Leu Lys
        115                 120                 125

Arg Ala Arg Arg Ser Met Glu Leu Ile Ala Arg Glu Asp Glu Asn Pro
    130                 135                 140

Lys Val Ala Glu Val Ile Tyr Pro Ile Met Gln Val Asn Gly Cys His
145                 150                 155                 160

Tyr Arg Gly Val Asp Val Ala Val Gly Gly Met Glu Gln Arg Lys Ile
                165                 170                 175

His Met Leu Ala Arg Glu Leu Leu Pro Lys Lys Val Val Cys Ile His
            180                 185                 190

Asn Pro Val Leu Thr Gly Leu Asp Gly Glu Gly Lys Met Ser Ser Ser
        195                 200                 205

Lys Gly Asn Phe Ile Ala Val Asp Asp Ser Pro Glu Glu Ile Arg Ala
    210                 215                 220

Lys Ile Lys Lys Ala Tyr Cys Pro Ala Gly Val Val Glu Gly Asn Pro
225                 230                 235                 240

Ile Met Glu Ile Ala Lys Tyr Phe Leu Glu Tyr Pro Leu Thr Ile Lys
                245                 250                 255

Arg Pro Glu Lys Phe Gly Gly Asp Leu Thr Val Asn Ser Tyr Glu Glu
            260                 265                 270

Leu Glu Ser Leu Phe Lys Asn Lys Glu Leu His Pro Met Asp Leu Lys
        275                 280                 285

Asn Ala Val Ala Glu Glu Leu Ile Lys Ile Leu Glu Pro Ile Arg Lys
    290                 295                 300
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Arg Leu
305

<210> 19
<211> 306
<212> PRT
<213> artificial

<220>
<223> tRNA synthetase based on M. jannaschii tyrosyl-tRNA synthetase

<400> 19

Met Asp Glu Phe Glu Met Ile Lys Arg Asn Thr Ser Glu Ile Ile Ser
1 5 10 15

Glu Glu Glu Leu Arg Glu Val Leu Lys Lys Asp Glu Lys Ser Ala Leu
20 25 30

Ile Gly Phe Glu Pro Ser Gly Lys Ile His Leu Gly His Tyr Leu Gln
35 40 45

Ile Lys Lys Met Ile Asp Leu Gln Asn Ala Gly Phe Asp Ile Ile Ile
50 55 60

Leu Leu Ala Asp Leu His Ala Tyr Leu Asn Gln Lys Gly Glu Leu Asp
65 70 75 80

Glu Ile Arg Lys Ile Gly Asp Tyr Asn Lys Lys Val Phe Glu Ala Met
85 90 95

Gly Leu Lys Ala Lys Tyr Val Tyr Gly Ser Glu Phe Gln Leu Asp Lys
100 105 110

Asp Tyr Thr Leu Asn Val Tyr Arg Leu Ala Leu Lys Thr Thr Leu Lys
115 120 125

Arg Ala Arg Arg Ser Met Glu Leu Ile Ala Arg Glu Asp Glu Asn Pro
130 135 140

Lys Val Ala Glu Val Ile Tyr Pro Ile Met Gln Val Asn Gly Thr His
145 150 155 160

Tyr Arg Gly Val Asp Val Ala Val Gly Gly Met Glu Gln Arg Lys Ile
165 170 175

His Met Leu Ala Arg Glu Leu Leu Pro Lys Lys Val Val Cys Ile His
180 185 190

Asn Pro Val Leu Thr Gly Leu Asp Gly Glu Gly Lys Met Ser Ser Ser
195 200 205

Lys Gly Asn Phe Ile Ala Val Asp Asp Ser Pro Glu Glu Ile Arg Ala

210 215 220

Lys Ile Lys Lys Ala Tyr Cys Pro Ala Gly Val Val Glu Gly Asn Pro
225 230 235 240

Ile Met Glu Ile Ala Lys Tyr Phe Leu Glu Tyr Pro Leu Thr Ile Lys
245 250 255

Arg Pro Glu Lys Phe Gly Gly Asp Leu Thr Val Asn Ser Tyr Glu Glu
260 265 270

Leu Glu Ser Leu Phe Lys Asn Lys Glu Leu His Pro Met Asp Leu Lys
275 280 285

Asn Ala Val Ala Glu Glu Leu Ile Lys Ile Leu Glu Pro Ile Arg Lys
290 295 300

Arg Leu
305

<210> 20
<211> 306
<212> PRT
<213> artificial

<220>
<223> tRNA synthetase based on M. jannaschii tyrosyl-tRNA synthetase

<400> 20

Met Asp Glu Phe Glu Met Ile Lys Arg Asn Thr Ser Glu Ile Ile Ser
1 5 10 15

Glu Glu Glu Leu Arg Glu Val Leu Lys Lys Asp Glu Lys Ser Ala Ala
20 25 30

Ile Gly Phe Glu Pro Ser Gly Lys Ile His Leu Gly His Tyr Leu Gln
35 40 45

Ile Lys Lys Met Ile Asp Leu Gln Asn Ala Gly Phe Asp Ile Ile Ile
50 55 60

Leu Leu Ala Asp Leu His Ala Tyr Leu Asn Gln Lys Gly Glu Leu Asp
65 70 75 80

Glu Ile Arg Lys Ile Gly Asp Tyr Asn Lys Lys Val Phe Glu Ala Met
85 90 95

Gly Leu Lys Ala Lys Tyr Val Tyr Gly Ser Glu Phe Gln Leu Asp Lys
100 105 110

Asp Tyr Thr Leu Asn Val Tyr Arg Leu Ala Leu Lys Thr Thr Leu Lys
115 120 125

Arg Ala Arg Arg Ser Met Glu Leu Ile Ala Arg Glu Asp Glu Asn Pro
130 135 140

Lys Val Ala Glu Val Ile Tyr Pro Ile Met Gln Val Asn Gly Gly His
145 150 155 160

Tyr Leu Gly Val Asp Val Ile Val Gly Gly Met Glu Gln Arg Lys Ile
165 170 175

His Met Leu Ala Arg Glu Leu Leu Pro Lys Lys Val Val Cys Ile His
180 185 190

Asn Pro Val Leu Thr Gly Leu Asp Gly Glu Gly Lys Met Ser Ser Ser
195 200 205

Lys Gly Asn Phe Ile Ala Val Asp Asp Ser Pro Glu Glu Ile Arg Ala
210 215 220

Lys Ile Lys Lys Ala Tyr Cys Pro Ala Gly Val Val Glu Gly Asn Pro
225 230 235 240

Ile Met Glu Ile Ala Lys Tyr Phe Leu Glu Tyr Pro Leu Thr Ile Lys
245 250 255

Arg Pro Glu Lys Phe Gly Gly Asp Leu Thr Val Asn Ser Tyr Glu Glu
260 265 270

Leu Glu Ser Leu Phe Lys Asn Lys Glu Leu His Pro Met Asp Leu Lys
275 280 285

Asn Ala Val Ala Glu Glu Leu Ile Lys Ile Leu Glu Pro Ile Arg Lys
290 295 300

Arg Leu
305

<210> 21
<211> 77
<212> RNA
<213> Methanococcus jannaschii

<400> 21
ccggcgguag uucagcaggg cagaacggcg gacucuaaau ccgcauggcg cugguucaaa 60

uccggcccgc cggacca 77

<210> 22
<211> 10
<212> PRT
<213> Artificial

<220>
<223> N-terminal tryptic peptide of Z domain protein including p-acetyl
-L-phenylalanine

<220>
<221> MISC_FEATURE
<222> (7)..(7)
<223> X is p-acetyl-L-phenylalanine

<400> 22

Met Thr Ser Val Asp Asn Xaa Ile Asn Lys
1 5 10

<210> 23
<211> 38
<212> DNA
<213> Artificial

<220>
<223> PCR primer

<400> 23
gaggaatccc atatggacga atttgaaatg ataaagag 38

<210> 24
<211> 36
<212> DNA
<213> Artificial

<220>
<223> PCR primer

<400> 24
cgtttgaaac tgcagttata atctctttct aattgg 36